

9.1 A seesaw molecular geometry comes from removing an equatorial atom from a trigonal bipyramidal domain structure.

9.2

a) 120°

b) If the blue balloon gets larger the angle between the green and red gets smaller.

c) Part b illustrates the fact that the actual bond angles in molecules with unbonded electron pairs or multiple bonds are smaller than the base angles predicted by domain geometry, because double bonds, triple bonds, and unbonded pairs are larger than single bonds.

9.3 a) linear, trigonal bipyramidal or linear (5 or 2)

b) trigonal bipyramidal (5)

c) octahedral (6)

d) octahedral (6)

e) octahedral (6)

f) trigonal bipyramidal (5)

9.4 a) 4 electron domains

b) This molecule has a nonzero dipole moment

c) This molecule will be polar toward the more electronegative fluorine atoms.

9.5 a) An energy of zero on this curve represents no attraction between the atoms

b) According to the valence bond model, as these atoms approach each other, a valence electron from each atom (with opposite spins) pair, creating a region of increased electron density that each nucleus is attracted to, causing stabilization and a decrease in energy.

c) The distance at the minimum point in the plot is the bond length in Cl_2 .

d) Energy increases to the right of the minimum because attraction decreases; to the left it increases because repulsion increases.

e) The distance between the minimum on the curve and the x axis represents bond strength.

9.16a) Since these molecules are both tetrahedral and symmetrical, they should both have bond angles of about 109.5° .

b) The trigonal planar BF_3 molecule is flat.

9.21a) SiH_4 has no nonbonding electrons

b) PF_3 has 1 pair of nonbonding electrons which cause its shape to be trigonal pyramidal.

c) HBr has 3 pairs of nonbonding electrons, but they don't effect the shape.

d) HCN has nonbonding electrons on the N but they don't effect the shape.

e) SO_2 has nonbonding electrons on the sulfur that effect the shape.

9.22

- a) H_2S is bent, making the bond angle less than 109.5° , making it uncertain.
- b) BCl_3 is trigonal planar and symmetrical, making us confident the bond angles are 120° .
- c) CH_3I is tetrahedral, but not symmetrical, making us uncertain of its bond angle.
- d) CBr_4 is tetrahedral and symmetrical, making us confident the bond angles are 109.5° .
- e) TeBr_4 has one unbonded pair of electrons, making us uncertain of its bond angle.

- 9.24a) trigonal planar, trigonal planar
- b) tetrahedral, trigonal pyramid
- c) tetrahedral, bent

- 9.25a) linear, linear
- b) tetrahedral, trigonal pyramid
- c) trigonal bipyramidal, seesaw
- d) octahedral, octahedral
- e) tetrahedral, tetrahedral
- f) linear, linear

9.27

a) i-trigonal planar ii-tetrahedral iii-trigonal bipyramidal

b) i - none ii - one iii- two

c) N,P

d) Cl, Br, or I. In order for this structure to form, the central atom must have 7 valance electrons.

9.30

1) 109.5° 2) 120° 3) 109.5° 4) 120° 5) 109.5° 6) 109.5° 7) 180°

8) 109.5°

9.37

a) SCl_2 does have a dipole moment because it has a bent domain geometry and is therefore non-symmetrical. It is polar toward the more electronegative chlorine atoms.

b) BeCl_2 does not have a dipole moment because it is linear and therefore symmetrical.

9.41a) Polar b) Nonpolar c) Nonpolar

d) Polar e) Nonpolar f) Polar

9.44 Ortho and Meta have nonzero dipole moments.